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Some Comparative Methods of Packaging

POTATOES AND ONIONS

At the Point of Distribution

U. S. DEPARTMENT OF AGRICULTURE
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This study of packaging methods for potatoes and onions is a part of an overall study of retail produce departments. The study on which this report is based was conducted under authority of the Agricultural Marketing Act of 1946, and under the supervision of R. W. Hoecker, Head, Wholesaling and Retailing Section, Transportation and Facilities Branch, Marketing Research Division, Agricultural Marketing Service.

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SUMMARY

A comparison of 6 methods of bagging potatoes and onions in the retail store, and 2 methods of bagging potatoes in a central warehouse showed considerable differences in labor productivity and bagging costs among the various methods.

The productivity of the potato and onion bagging operation in the retail store can be increased 41, 14, and 31 percent for 3-pound bags of onions and 5- and 10-pound bags of potatoes, respectively, when a lightweight aluminum scoop is used for filling the bags, as compared to filling them by hand. The use of a small automatic bagging machine in the back room of the store increased production 60, 59, and 89 percent for 3-, 5-, and 10-pound packages over the standard method of filling the bags by hand.

A comparison of the cost of store packaging with warehouse packaging of potatoes was made by analyzing all direct costs which were influenced by where the product was packaged. These preliminary results indicate that the most productive warehouse method studied cost 67.5 percent more than conventional hand methods in the retail store. This was due primarily to increased handling costs in delivery, a higher bag cost because of the need for a stronger bag in the warehouse, and the extra weight of potatoes needed in the bag to allow for shrinkage when bagging in the warehouse. Among other factors which will influence the decision whether to bag in the store or at the central warehouse are: (1) The relative sales appeal of the bag; (2) condition of the merchandise when it is placed on the shelf; (3) reduced labor requirements at store level; and (4) provision of adequate displays of bagged potatoes at all times.

SOME COMPARATIVE METHODS OF PACKAGING POTATOES AND ONIONS AT THE POINT OF DISTRIBUTION

By Paul F. Shaffer and Dale L. Anderson
marketing specialists, Transportation
and Facilities Branch, Agricultural
Marketing Service

INTRODUCTION

There appear to be nearly as many methods of and devices for bagging potatoes and onions in the retail food stores as there are enterprising employees. These range from filling the bags manually or with a scoop shovel to filling with machines that make the operation almost completely automatic. This report analyzes briefly some of the most common methods found in retail stores and central warehouses, discusses improved methods and equipment developed during the study, and compares the direct costs of performing the bagging operation in the warehouse with the costs of performing it in the retail store.

Over 4,000 bags of produce, containing either 3 pounds of onions or 5 or 10 pounds of potatoes, were time-studied in 8 stores and 2 warehouses. Several operators were studied using each bagging method. Essentially the same type and grade of potatoes and onions stocked in 50- and 100-pound bags were used in each method. A clipper-type stapler was used for closing bags in all methods studied. Two types of bagging machines were used for the warehouse studies of repacking 100-pound sacks of potatoes into 10-pound consumer bags. Since there were differences in handling times, in the shrinkage allowance, and in types of bags used, the comparison of store and warehouse bagging takes these differences into account.

PACKAGING IN THE RETAIL STORE

Essentially, the three basic elements to the job of packaging potatoes or onions are filling, weighing, and closing the bag. These operations can be performed in either one place by one person or at different work stations by different operators. Production per man-hour of 5- and 10-pound bags of potatoes and 3-pound bags of onions was determined for six different methods of packaging these items in the retail store.

Method A: Hand filling at table in the back room. Filling and weighing the package by hand at a table in the back room was one of the simplest and most common methods of packaging encountered. For purposes of this report this method will be referred to as "standard" and other methods of packaging will be compared with it. In using this method potatoes or onions were dumped on a 3- by 6-foot, rimmed, metal-lined table (fig. 1). Both hands were used to fill the bag after there was sufficient weight in the bottom to hold the mouth of the bag open. When the bag was filled to the approximate desired weight it was weighed on a scale located on the table and its weight adjusted by adding or subtracting units. The bag was moved to the table where it was closed, stapled, and placed on a platform-type stocking truck. A definite work-place was provided for the scale and tools. Production measured in number of

Filling the bag.

Weighing potatoes.

Figure 1.--Hand filling in back room. Method A.

units packaged per man-hour was 65 10-pound bags of potatoes, 90 5-pound bags of potatoes, and 91 3-pound bags of onions.

Method B: Hand filling at station in display room of store. The entire packaging operation was performed at the produce service station by the scale operator during periods when there were no customers to serve. The potatoes and onions were dumped into bushel baskets in the back room, placed on platform-type stocking trucks and wheeled to the service station. The 10-, 5-, or 3-pound bags were filled by hand, placed on the scale and weighed, closed and stapled, and placed in a bascart. Production of the various size of bags is shown in table 1.

Table 1.--Number of bags filled per man-hour, by hand, in the back room and at produce service station

Commodity and size of package	Hand filling at table in back room, method A	Hand filling at station in front store, method B	Decrease in production of method B over method A
	Number	Number	Percent
Onions, 3-lb...	91	61	33
Potatoes, 5-lb.	90	60	33
Potatoes, 10-lb	65	49	25

Production for method B was 33, 33, and 25 percent less for 3, 5, and 10 pounds of produce, respectively, than for method A. In variations of method B the bags were filled (1) in the back room by hand and (2) by the foot-operated gravity bagger (described in later section) and then moved to the service station in the front of the store where they were weighed and closed. In neither case was productivity increased appreciably.

Method C: Bag well with hand scoop. The same packaging table used in method A was used but instead of filling the bags by hand a lightweight aluminum scoop was used. This hand scoop has a capacity of approximately 5 pounds (see fig. 2). An over-under fan-type scale was used on which a 3-sided well was substituted for the usual scale scoop. The empty bag was selected from an inclined bag shelf adjacent to and on the same level as the 3-sided well, and positioned in the well (see fig. 2). Two full scoops or three partially filled scoops approximated a 10-pound bag. The use of 2 full scoops required the least time to fill the bag. The operator then added or removed potatoes to obtain the desired weight.

When putting potatoes in 5-pound bags one full scoop of potatoes was placed in the bag and the balance added by hand, if necessary. One partially-filled scoop of onions weighs about 3 pounds. In each instance the bag was closed and stapled in the well, and then placed on the platform-type stocking truck. The workplace arrangement positioned the top of the bag in the well at a convenient height for the average operator. The clipper-type stapler was conveniently located on a shelf to the right of the bag well. A comparison of production obtained with method C and method A is shown in table 2.

Aluminum scoop

Bagging potatoes

Scale with bag well and bag holder

Figure 2.--Bagging potatoes and onions with hand scoop and modified scale. Method C.

Method C was 41, 14, and 31 percent more productive for 3-, 5-, and 10-pound packages of produce, respectively, than method A.

Table 2.--Number of bags filled per man-hour, by hand and with a hand scoop

Commodity and size of package	Hand filling at table in back room, method A	Bag well with hand scoop, method C	Increase in production of method C over method A
	Number	Number	Percent
Onions, 3-lb.....	91	128	41
Potatoes, 5-lb...	90	103	14
Potatoes, 10-lb..	65	85	31

Method D: Foot-operated gravity bagger. During the course of the study a semi-automatic bagging device was developed which facilitated the filling and weighing operations (fig. 3). This consisted of an inclined hopper with a capacity of approximately 300 pounds. A gate operated by a foot pedal controlled the flow of merchandise through a duckbill type spout which was adjustable for different size bags. Potatoes and onions in 50- and 100-pound bags were stacked on a 4-foot high bench as they were received in the store. The bagger was mounted on casters and was pushed to the storage bench and the 50- and 100-pound sacks were opened and dumped into the hopper. The operator sat on a stool that had a convenient shelf for storage of empty bags. In operation, the operator grasped a bag by the lip and inserted it over the spout. The foot pedal was then depressed opening the gate to allow units to roll into the bag. The weight of the potatoes falling into the bag opened the bottom of the bag. When the approximate weight was in the bag it was lowered onto a scale and weighed. The bag was then closed and placed on a truck. Production obtained on this equipment compared with production obtained using method A is shown in table 3.

Table 3.--Number of bags filled per man-hour by hand and with gravity-flow equipment

Commodity and size of package	Hand filling at table in back room, method A	Foot-operated gravity bagger, method D	Increase in production of method D over method A
	Number	Number	Percent
Onions, 3-lb.....	91	121	33
Potatoes, 5-lb...	90	113	26
Potatoes, 10-lb..	65	92	42

Method D was 33, 26, and 42 percent more productive for 3-, 5-, and 10-pound packages of produce, respectively, than method A. This type of bagger equipment cost approximately $40 to construct. Specifications may be obtained by writing the Transportation and Facilities Branch, Agricultural Marketing Service, U. S. Department of Agriculture.

Method E: Automatic bagging machine #1. (Fig. 4) The produce was placed in a dump hopper and elevated into a vibrating hopper, which moved

Figure 3.--Foot-operated gravity bagger. Method D.

Figure 4.--Automatic bagging machine #1 method E.

it into the weighing hopper. When the product in the hopper reached the predetermined weight the flow of the product was cut off automatically. The operator then added or removed the product to obtain the correct weight. After a bag was positioned over the dump chute the gates were opened by means of a foot pedal and the produce fell into the bag. The bag was then closed and moved to a foot-operated stapler for stapling after which it was placed on a platform truck. After initial tests, several changes were made in this equipment: (1) The bags were positioned close to the dump chute and to the right of the operator; (2) the stapler was positioned nearer to the left of the dump chute; and (3) a platform-type stocking truck was located to the left of the operator and adjacent to the stapler. The machine was then tested for bagging potatoes in 10-pound sacks. Production was 105 bags per man-hour compared to 65 bags per man-hour for method A, or 62 percent greater.

Method F: automatic bagging machine #2. The produce was dumped into a hopper with 200-pound capacity (fig. 5). It was then elevated and dropped into a tilting chute connected to the over-under type scale mechanism. The chute was tilted, dumping the contents into a bag as soon as the correct weight was obtained. As the operator could easily see the quantity of produce in the bagging head, he quickly learned to estimate closely the correct weights. Various attachments for the machine make it possible to use it to bag a variety of produce items in sizes from 2 to 10 pounds in paper, polyethelene, or mesh bags. During the test the machine was modified as follows:

(1) A shelf was attached to the hopper to facilitate the dumping of the product. The 50- or 100-pound bag was placed on the shelf and then opened. As the shelf was slightly inclined, some of the product rolled into the hopper by gravity.

(2) The empty-bag storage shelf was altered to place the bag directly to the right and on the same plane as the bag holder (fig. 5).

(3) An adjustable bag support platform on the paper bag holder prevented tearing the bags when successive large potatoes rolled into the bag.

(4) A stool with an adjustable shelf on which to staple the filled bag was designed for the operator.

The most productive method of bagging with this machine resulted from the use of the attachment to hold the paper bags. The empty bag was attached to the bag holder and the machine was started in one motion. The bag, which had been filled previously and balanced for the correct weight, was resting between the operator's legs on the adjustable shelf. While the empty bag was being filled, the operator closed, stapled, and placed the full bag on a platform truck at his left. The next bag was then balanced, removed, and placed on the shelf and an empty bag was placed on the bag holder. A comparison of the number of bags packaged by this method and the number packaged by method A is shown in table 4.

Table 4.--Number of bags filled per man-hour by hand and with automatic bagging machine #2

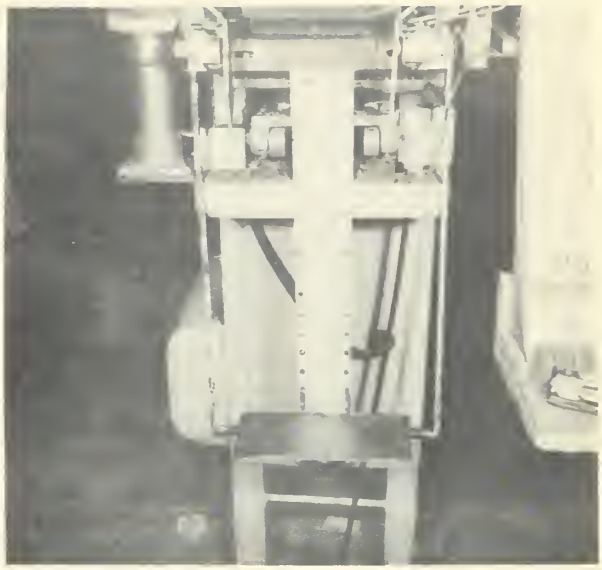
Commodity and size of package	Hand filling at table in back room, method A	Automatic bagging machine #2, method F	Increase in production of method F over method A
	Number	Number	Percent
Onions, 3-lb.....	91	146	60
Potatoes, 5-lb....	90	143	59
Potatoes, 10-lb...	65	123	89

This was the most productive method studied for bagging potatoes and onions in the retail stores. It was 60, 59, and 89 percent more productive for 3, 5, and 10 pounds of produce, respectively, than method A. A controlled tilting bagging head in conjunction with a special hopper attachment enables the operator to bag apples and other tender produce.

PACKAGING IN A CENTRAL WAREHOUSE

In order to learn where potatoes and onions could be packaged most economically, studies were made of two types of bagging operations in the central warehouse. Data on these bagging operations were obtained only for potatoes put in 10-pound bags. Spot studies indicated the same relative differences would be obtained if potatoes packed in 5-pound bags and onions

Note stool and empty bag shelf.



Adjustable bag support shelf on paper bag holder.

Side view of bagging machine #2

Figure 5.--Automatic bagging machine #2.

in 3-pound bags were studied. In each study a double-wall kraft bag with a mesh window was used. It was found that single-strength bags would not withstand the numerous handlings between packaging and display.

Method A: A machine similar in principle to the one used in method E in the store was used. The 100-pound bags of potatoes were dumped onto a roller conveyor which fed them over a blower and dumped them in a hopper. They were then elevated into a shaker-type hopper where they were weighed. When the predetermined weight was obtained, the potatoes were dropped into the dump hopper or chute. The operator then opened the chute and the potatoes rolled into the bag. The bag was positioned on a scale to check the weight and then placed on a belt conveyor where the bag moved to a stitching machine. The closed bag was placed on a rack-type pallet.

The potato bagging setup was operated by an $8\frac{1}{2}$-man crew (one man working half-time on this job); each crew member performed one of the following duties:

(1) Dump potatoes on roller conveyor.

(2) Assist flow of potatoes up elevating conveyor and oversee entire operation.

(3) Obtain empty 10-pound bag and open.

(4) Position bag at chute and fill and drop on moving belt.

(5) Lift bag from belt and position it on scale, occasionally help weigh.

(6) Weigh (add or remove potatoes) and place bag on belt conveyor.

(7) Stitch bag.

(8) Dispose of closed bag to skid or rack-type pallet.

(9) Deliver 100-pound bags on pallets and haul away 10-pound bags. (Performed by lift truck operator who serviced two bagging machines.)

No machine breakdown time was charged to this operation. Production was 567 10-pound bags per hour for the crew or 67 bags per man-hour.

Method B: A 4-station packaging belt was used in this method of filling 10-pound bags of potatoes in a central warehouse. As in method A, 100-pound sacks of potatoes were dumped on a roller conveyor which fed them through a blower and dropped them on a 2-way belt. The belt provided continuous circulation of produce past the four filling stations. Empty bags were clamped on the dump chutes and a baffle was used by the operator to direct produce into the bag. Each bagging head was attached to an

over-under type scale. When the predetermined weight was obtained the bag was removed from the chute and placed on a conveyor belt which moved it to a stitcher. The bag was closed and moved to the end of the belt conveyor where it either dropped into an accumulation box or was placed on a rack-type pallet.

The equipment was operated by a 7½-man crew (one man working half-time). Each crew member performed one of the following duties:

(1) Dump potatoes on roller conveyor.

(2) Fill and weigh 10-pound bag and place on conveyor belt. (Performed by 4 members of the crew.)

(3) Stitch bags.

(4) Remove bags from conveyor and position on skids or rack-type pallet.

(5) Deliver 100-pound bags of potatoes on pallets and haul away 10-pound bags. (Performed by fork lift operator who serviced two bagging machines.)

As in method A, no machine breakdown time was charged to this operation. Production was 561 bags per hour for the crew or 75 bags per man-hour.

COMPARATIVE COSTS OF PACKAGING IN THE STORE AND IN A CENTRAL WAREHOUSE

A comparison of the cost of store packaging with warehouse packaging was made by analyzing all direct costs influenced by the location of the packaging (table 5). When bagged at the warehouse, the delivering of the 10-pound bags to the stores required that they be placed either in relatively expensive containers or handled individually. In this study the bags were moved into the trailer at the loading platform on the rack-type pallet from which they were stacked individually with the respective store orders. At the store 2 to 5 bags were unloaded simultaneously.

In contrast, when bagged in the store the potatoes were delivered from the warehouse and into the back room of the store in units of 100 pounds. At the warehouse loading platform several 100-pound bags were moved to the trailer on pallets.

Allowance for shrinkage, a variable cost item, was affected in part by the length of time between packaging and sale of the product. Actual shrinkage allowance was measured by weighing a large number of 10-pound bags of potatoes packaged by each method.

Table 5.--Labor and cost per 100 pounds for packaging potatoes in 10-pound bags by 6 methods in the retail store and by 2 methods in the central warehouse

Cost item	Packaging in store						Packaging in warehouse	
	Hand filling at table in back room method A	Hand filling at station in front store: method B	Bag well with hand scoop method C	Foot operated gravity bagger method D	Automatic bagging machine #1 method E	Automatic bagging machine #2 method F	Method A	Method B
	Man-minutes	Man-minutes	Man-minutes	Man-minutes	Man-minutes	Man-minutes	Man-minutes	Man-minutes
Labor:								
Loading trailer at warehouse	0.861	0.861	0.861	0.861	0.861	0.861	1.357	1.357
Unloading trailer at store	.877	.877	.877	.877	.877	.877	2.072	2.072
Bagging	9.200	12.300	7.030	6.540	5.700	4.880	1/ 8.990	1/ 8.020
Total time	10.938	14.038	8.768	8.278	7.438	6.618	12.419	11.449
	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents
Cost:								
Labor:								
Loading trailer at warehouse 2/	1.464	1.464	1.464	1.464	1.464	1.464	2.307	2.307
Unloading trailer at store 3/	1.754	1.754	1.754	1.754	1.754	1.754	4.144	4.144
Bagging 4/	18.400	24.600	14.060	13.080	11.400	9.760	2/ 15.283	2/ 13.634
Total labor	21.618	27.818	17.278	16.298	14.618	12.978	21.734	20.085
Shrinkage allowance at 4 cents per pound 5/	5.000	5.000	5.000	5.000	5.500	5.000	11.000	6.260
Bag 6/	10.000	10.000	10.000	10.000	10.000	10.000	35.000	35.000
Total cost	36.618	42.818	32.278	31.298	30.118	27.978	67.734	61.345
Average cost per 10-pound bag	3.7	4.3	3.2	3.1	3.0	2.8	6.8	6.1

1/ Assumes no breakdown time.

2/ Warehouse labor @ $1 per hour or 1.7¢ per man-minute.

3/ Unloading labor @ $1.20 per hour or 2.0¢ per man-minute.

4/ Store labor @ $1.20 per hour or 2.0¢ per man-minute.

5/ Shrinkage allowance per 10-pound bag - 2 oz. A, B, C, D, F stores; 2.2 oz. E store; on A warehouse 4.4 oz.; warehouse B 2.5 oz.

6/ Estimated bag cost based on printed and unprinted single kraft bags for store and printed double kraft mesh window bags for warehouse.

It was assumed that a double-wall kraft bag had to be used in the warehouse operation to prevent broken bags in subsequent handlings. Although some stores used a double-wall kraft bag with a mesh window for 10-pound bags, this was not necessary when a good quality single-wall kraft bag was used. In this comparison the cost of a single-wall kraft bag was used because one major advantage of store packaging was that it permitted the use of the less expensive single-strength bags. The individual operator may substitute his own costs in table 5 to determine what his comparative costs would be for store or warehouse packaging.

These preliminary results indicate that the best warehouse methods studied cost 67.5 percent more than the conventional store methods and 118 percent more than the best store method of bagging potatoes (fig. 6). It is undoubtedly possible to improve upon the warehouse bagging operations studied, but even if the cost of all warehouse labor for prepacking is eliminated the warehouse bagging costs are still 11.4 percent higher than the most expensive store method studied. The higher cost of bags, the larger shrinkage allowance, and the extra handling of potatoes bagged in the warehouse cause the retail store to be the most economical place to bag potatoes when only labor and material costs are considered.

Other factors that will influence the decision whether to bag in the store or at the central warehouse are:

(1) The relative sales appeal of the bag. Several studies have measured the relative sales appeal of different types of bags for packaging potatoes, such as pliofilm, polyethelene, and single-wall and double-wall kraft bags with and without the mesh window. Other studies have compared washed and unwashed potatoes. Although the importance of these factors on sales is recognized, this study was restricted to a comparison of equipment and methods.

(2) Condition of the merchandise when it is placed on the shelf. The condition of the merchandise on display depends on the condition of the potatoes or onions when they were placed in the package, the type of package, and the number of handlings between packaging and point of sale.

(3) Reduced labor requirements at store level. Whether warehouse packaging will reduce store labor requirements depends on how well the work is scheduled in the store.

(4) Adequate displays of bagged potatoes at all times. Having adequate displays depends on how well the manager can order packaged potatoes from the warehouse or, when the packaging operation takes place in the store, or how well he schedules his packaging labor. Hence, in either instance, adequate displays are the result of proper planning and scheduling by the store manager.

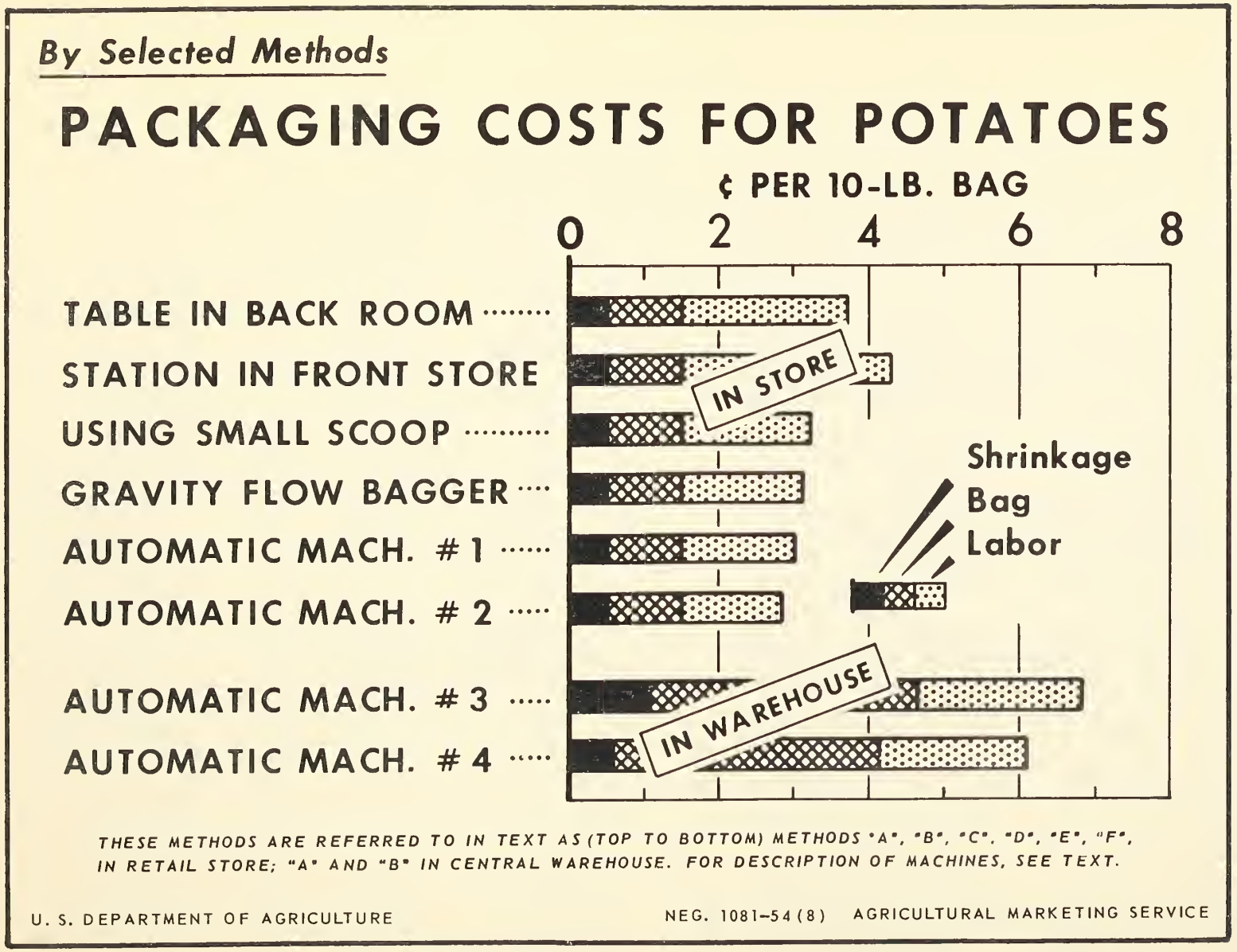

By Selected Methods
PACKAGING COSTS FOR POTATOES
¢ PER 10-LB. BAG
0
2
4
6
8
TABLE IN BACK ROOM
STATION IN FRONT STORE
USING SMALL SCOOP
GRAVITY FLOW BAGGER
AUTOMATIC MACH. # 1
AUTOMATIC MACH. # 2
AUTOMATIC MACH. # 3
AUTOMATIC MACH. # 4
IN STORE
IN WAREHOUSE
Shrinkage
Bag
Labor
THESE METHODS ARE REFERRED TO IN TEXT AS (TOP TO BOTTOM) METHODS "A", "B", "C", "D", "E", "F", IN RETAIL STORE; "A" AND "B" IN CENTRAL WAREHOUSE. FOR DESCRIPTION OF MACHINES, SEE TEXT.
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Figure 6.--Chart showing packaging costs for potatoes by selected methods.